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*New Lower Estimate for soils contaminated with secondary explosives and the associated implications*

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13. ABSTRACT This report gives an estimate of the volume of explosives-contaminated soil requiring remediation at selected Army installations as of March 1997. It also estimates a total cost of treating this soil. The report describes the process and assumptions used to identify installations with known or suspected contamination, identifies sites likely to require treatment, and estimates the volume of contaminated soil at each selected site. Finally, it compares this new soil volume estimate with a previous estimate, explains why they differ, and describes the implications of these results.  Based on 1996 data, there is an estimated total of 287,000 cubic yards of explosives-contaminated soil at 15 installations requiring excavation and treatment. For this estimate, the contaminants of concern were primarily trinitrotoluene (TNT), Royal Demolition Explosive (RDX), and High Melting Explosive (HMX). Our report does not include (a) sites where treatment has been completed, is in progress, or will begin in FY97, (b) sites contaminated by primary explosives, (c) sites contaminated only by propellants, or (d) Formerly Used Defense Sites. It also does not address ground water contamination, which was outside the scope of this task. The cost estimate for treating this soil using composting is between \$116 million and \$134 million.					
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## **New Lower Estimate for Soils Contaminated With Secondary Explosives and the Associated Implications**

**Purpose:** This report gives an estimate of the volume of explosives-contaminated soil requiring remediation at selected Army installations as of March 1997. It also estimates a total cost of treating this soil, assuming the use of composting for the treatment. The report describes the process and assumptions used to identify installations with known or suspected contamination, identifies sites likely to require treatment, and estimates the volume of contaminated soil at each selected site. Finally, it compares this new soil volume estimate with a previous estimate, explains why they differ, and describes the implications of these results. This report does not include Formerly Used Defense Sites (FUDS) since this data was not available to TRW.

**Results:** Based on 1996 data, TRW estimates a total of 287,000 cubic yards (287 kilocubic yards (Kyd<sup>3</sup>)) of explosives-contaminated soil at 15 installations (54 sites) requiring excavation and treatment. The cost estimate for treating this soil using composting is between \$116 million and \$134 million, based on the figures and conclusions in the *Cost Report: Windrow Composting to Treat Explosives-Contaminated Soils at Umatilla Army Depot Activity (UMDA)* (ref. 1). These estimates were based on the use of composting because it offers the lowest overall unit cost for the low soil volumes identified for treatment at each installation. The \$134 million estimate assumes a treatment cost of \$467 per cubic yard (\$346 per ton), the documented cost for composting at UMDA, while the \$116 million estimate assumes a hypothetical lowest unit cost of \$404 per cubic yard (\$299 per ton). (These unit treatment costs do not include U.S. Army Corps of Engineers costs for support and contracts.) The lower unit cost is based on cost savings that are possible if recommendations in the UMDA cost report are followed. Table 1 shows the soil volumes and treatment costs for the fifteen installations where future remediation is required.

**Assumptions:** For TRW's estimates, the contaminants of concern were primarily trinitrotoluene (TNT), Royal Demolition Explosive (RDX), and High Melting Explosive (HMX). Our report does not include (a) sites where treatment has been completed, is in progress, or will begin in FY97, (b) sites contaminated by primary explosives (nitroglycerine, lead azide, and lead styphnate), (c) sites contaminated only by propellants, or (d) FUDS. It also does not address ground water contamination, which was outside the scope of TRW's tasking.

**Research & Analysis Methods:** TRW arrived at these estimates through a four-step process that used four data sources. First, installations with known or suspected explosives contamination were identified either by querying the Defense Site Environmental Restoration Tracking System (DSERTS) database for explosives-contaminated soil or through knowledge of current or former installation missions. The result was a list of 50 installations (see Table A-1) that required further investigation.

**Table 1. Summary of Soil Volumes and Treatment Costs**

Installation & Location	Soil Volume (Kyd <sup>3</sup> )	Estimated Treatment Cost (thousands of \$)	
		High	Low
Aberdeen Proving Ground <i>Aberdeen, MD</i>	10	4,670	4,040
Anniston AD <i>Anniston, AL</i>	27	12,609	10,908
ARDEC (Picatinny Arsenal) <i>Dover, NJ</i>	17	7,939	6,868
Bluegrass AD <i>Richmond, KY</i>	2	934	808
Camp Navajo <i>Flagstaff, AZ</i>	7	3,269	2,828
Dugway Proving Ground <i>Dugway, UT</i>	5	2,335	2,020
Fort Irwin <i>San Bernardino County, CA</i>	4	1,868	1,616
Fort Wingate <i>Gallup, NM</i>	27	12,609	10,908
Kansas AAP <i>Parsons, KS</i>	24	11,208	9,696
Longhorn AAP <i>Marshall, TX</i>	4	1,868	\$1,616
Radford AAP <i>Radford, VA</i>	10	4,670	4,040
Ravenna AAP <i>Ravenna, OH</i>	55	25,685	22,220
Seneca AD <i>Romulus, NY</i>	10	4,670	4,040
Sunflower AAP <i>Desoto, KS</i>	83	38,761	33,532
Volunteer AAP <i>Chattanooga, TN</i>	2	934	808
<b>Total</b>	<b>287</b>	<b>134,029</b>	<b>115,948</b>

Second, the author used several government proprietary documents made available during the research: Installation Action Plans (IAPs), Base Realignment and Closure (BRAC) Cleanup Plans, and the Cost-to-Complete Report. The IAPS and BRAC Cleanup Plans identify and document the status of all sites with known or suspected contamination at the installations, describing each site, its historical uses, contaminants, nature and extent of contamination, and other relevant information. These plans are written and published by the installations, and updated annually. The Cost-to-Complete

Report is a U.S. Army Environmental Center (USAEC) document that identifies the types and costs of cleanup actions for each site where remedial action has been projected. The report is updated periodically and coordinated with installation personnel to ensure that it reflects the current cleanup plans for the sites. The IAPs or BRAC Cleanup Plans were used to compile a list of 521 sites where there had been documented concerns about explosives contamination of the soil. Based on information from the IAPs, BRAC Cleanup Plans, and the Cost-to-Complete Report (ref. 2), several selection criteria were developed to narrow this list from 521 sites to the 54 sites judged likely to require treatment. Appendix B describes the selection criteria; Table B-1 lists the 54 sites requiring cleanup. Appendix C lists the remaining 467 sites and the reason(s) they were eliminated from consideration.

Third, a total volume of contaminated soil at these 54 sites was estimated. For most sites, we used the most recent volume estimates from the Cost-to-Complete Report, but for nine sites we made alternate estimates based on the site sizes documented in the IAPs and our assumptions about the site geometries. See Appendix D for the estimation methods for these nine sites.

Finally, TRW estimated a total cost of treating the soil, using the unit treatment cost from the *Cost Report: Windrow Composting to Treat Explosives-Contaminated Soils at Umatilla Army Depot Activity (UMDA)* as our basis. All assumptions and analysis methods underlying our site selection process, and soil volume and treatment cost estimates, are documented in Appendices B and D to facilitate comparisons with alternative estimates based on different assumptions.

**Comparison to Previous Work:** TRW's own detailed site characterization studies at Volunteer AAP, Louisiana AAP, and Holston AAP – conducted for the U.S. Army's National Environmental Technology Test Sites (NETTS) Program, sponsored by the Strategic Environmental Research and Development Program (SERDP), and managed by the USAEC – confirmed that the volume of contaminated soil at these three installations was significantly lower than earlier soil volume estimates. Because these installations had been identified among the most seriously contaminated installations Army-wide, it was concluded that initial site surveys tended to overestimate the extent of contamination at most Army installations. TRW's soil volume estimate of 287 Kyd<sup>3</sup> is 59 percent lower than the previous 706 Kyd<sup>3</sup> estimate made by Labat-Anderson in 1993, a difference of 419 Kyd<sup>3</sup>. There are two reasons for this major difference. First, their estimate included twelve installations not included in our estimate that have since been cleaned up or are currently undergoing cleanup, accounting for 354 Kyd<sup>3</sup> of the difference. This leaves only 65 Kyd<sup>3</sup> difference between the 1993 Labat-Anderson estimate and TRW's estimate. Second, our estimate was based on more recent and complete information available during March 1997 in the DSERTS database, 1996 IAPs and BRAC Cleanup Plans, and 1996 Cost-to-Complete Report. Discussions with USAEC personnel familiar with current conditions at relevant installations and sites also provided significant information and guidance for this report.

**Implications:** This smaller soil volume estimate has serious implications for Research and Development (R&D) policies and programs aimed at developing new, cost-saving treatment technologies. Potential cost savings from new technologies need to be great enough to recoup the development costs in order to provide cumulative savings. However, the volume of soil awaiting cleanup will continue to decrease as sites are cleaned up (while the new technologies are developed and tested), thus reducing the potential for recouping those development costs.

For example, based on today's estimated volume of 287 Kyd<sup>3</sup>, for every \$10 million invested in future R&D programs, new treatments must save at least \$35 per cubic yard, i.e.,

$$\$35/\text{yd}^3 = \$10 \text{ million} \div 287 \text{ Kyd}^3$$

just to recoup the research costs. However, many sites are projected for cleanup within the next five years; the IAPs have identified only 14 sites (a total soil volume of 39 Kyd<sup>3</sup> at five installations) for remediation in FY02 or later. Thus, the projected cost savings for treating this remaining soil volume must be at least \$256 per cubic yard, i.e.,

$$\$256/\text{yd}^3 = \$10 \text{ million} \div 39 \text{ Kyd}^3$$

to preclude losing, rather than saving, money. This means a new technology must cost less than \$211 per cubic yard, i.e.,

$$\$211/\text{yd}^3 = \$467/\text{yd}^3 - \$256/\text{yd}^3 = \text{current unit cost} - \text{minimum required savings}$$

before any actual savings can be achieved. In light of this, policy makers may wish to reevaluate the goals of ongoing or planned R&D programs, either curtailing the programs or redirecting their focus.



## References

- (1) U.S. Army Environmental Center (USAEC). *Cost Report: Windrow Composting to Treat Explosives-Contaminated Soils at Umatilla Army Depot Activity (UMDA)*. Report No. SFIM-AEC-ET-CR-96184. Prepared by TRW Inc. and Walcoff & Associates Inc. September 1996.
- (2) U.S. Army Environmental Center (USAEC). *Cost-to-Complete Report*. No report number. Prepared by TRW Inc. and Walcoff & Associates Inc. June 1995; updated May 1996.

# **Appendix A**

## **Installations Listed by Remediation Status**

## Installations Listed by Remediation Status

Our research considered a total of 50 installations, which were identified by two methods. First, a query of the DSERTS database for explosives-contaminated soil identified 33 installations. Next, an additional 17 installations were identified by USAEC personnel based on their knowledge of past installation missions. Missions that typically contaminate soil with explosives include explosives manufacturing; load, assembly, and packing; and munitions demilitarization. Table A-1 lists all fifty installations by their current status. It also shows the number of contaminated and estimated soil volume (in Kyd<sup>3</sup>) at these installations.

**Table A-1. Installations by Remediation Status**

Cleanup Completed			Cleanup in Progress		
Alabama AAP			Badger AAP		
Cornhusker AAP			Crane AAP		
Louisiana AAP			Hawthorne AAP		
Savanna AD			Iowa AAP		
Umatilla AD Activity			Joliet AAP		
			Milan AAP		
			Newport AAP		
			Pueblo Depot Activity		
			Sierra AD		
			Tooele AD		
Installations With Known or Suspected Contamination					
# sites   Kyd <sup>3</sup>			# sites   Kyd <sup>3</sup>		
Aberdeen Proving Ground	10	10	Lone Star AAP		0
Anniston AD	2	27	Longhorn AAP	2	4
ARDEC (Picatinny Arsenal)	12	17	McAlester AAP		0
Bluegrass AD	1	2	Radford AAP	1	10
Camp Navajo	2	7	Ravenna AAP	7	55
Dugway Proving Ground	1	5	Red River AD		0
Fort Carson		0	Redstone Arsenal		0
Fort Drum		0	Riverbank AAP		0
Fort Gordon		0	Seneca AD	2	10
Fort Irwin	1	4	Sunflower AAP	7	83
Fort Riley		0	Tobyhanna AD		0
Fort Sill		0	Twin Cities AAP		0
Fort Wingate	3	27	Volunteer AAP	2	2
Holston AAP		0	Watervliet Arsenal		0
Indiana AAP		0	West Point Military Academy		0
Kansas AAP	1	24	White Sands Missile Range		0
Lake City AAP		0	Yuma Proving Ground		0
Letterkenny AD		0			

Fifteen installations (shown at the top of Table A-1) had already been cleaned or are currently in cleanup, so we did not review IAPs or BRAC Cleanup Plans for them. A review of these plans was not considered necessary because annual updates generally identified fewer sites for cleanup than initially estimated (before extensive site characterization studies), so it was unlikely that previously unidentified sites would appear now. Also, ongoing efforts at the ten installations where cleanup is "in progress" are expected to complete all required remedial actions, leaving no contaminated soil for future cleanup.

For the remaining 35 sites with known or suspected contamination (shown at the bottom of the table), we reviewed the IAPs or BRAC Cleanup Plans to identify all sites where explosives-contaminated soil had been documented as a concern. We used a spreadsheet to compile data from these plans and the Cost-to-Complete Report to simplify site selection. Our site selection identified fifteen installations (a total of 54 sites) with explosives-contaminated soil requiring cleanup

Although the DSERTS query provided an initial basis for our research, the value of the USAEC's historical institutional knowledge of installation missions was proven during site selection. Of the 17 installations identified only through knowledge of past missions, two installations had significant volumes of contaminated soil. Ravenna AAP and Sunflower AAP had an estimated 55 Kyd<sup>3</sup> and 83 Kyd<sup>3</sup>, respectively, accounting for 48 percent of the estimated 287 Kyd<sup>3</sup> total volume.

# **Appendix B**

## **Site Selection Methodology**

## Site Selection Methodology

A process of elimination was used to develop our final list of 54 sites requiring cleanup. Our selection methodology began with the 521 sites (identified in the IAPs and BRAC Cleanup Plans), which we compiled in a spreadsheet. Although we initially assumed all sites would require cleanup, we identified several situations that are not consistent with that assumption and allow us to eliminate sites selectively. We excluded sites from the cleanup list when:

- (1) Soil sampling had shown explosives did not exceed trace levels.
- (2) The IAP indicated no further remedial action was planned. We assumed site studies had concluded that explosives contamination was not a problem.
- (3) The Cost-to-Complete Report did not include the site. We assumed that remedial actions were no longer required.
- (4) A joint TRW and USAEC review of the site history indicated that explosive contaminants were not likely.
- (5) Nitrocellulose and propellants were the only contaminants listed in the IAP. (Although propellants were not the primary concern for this effort, USAEC had requested that TRW compile a list of propellant-contaminated sites while reviewing the IAPs.)
- (6) The Cost-to-Complete Report included the site but did *not* include any soil remediation. We assumed installation personnel had determined that explosives contamination did not warrant cleanup.
- (7) The Cost-to-Complete Report indicated soil remediation by RCRA landfill disposal. We assumed the soil was not contaminated with explosives, because landfill disposal of explosives is prohibited by regulation.
- (8) The Cost-to-Complete Report indicated soil treatment by solidification, which is not used for treating explosives. However, we reviewed site descriptions in the IAPs for all these sites to verify, on a case-by-case basis, whether this assumption was valid. In a few cases, we decided to include the sites in our estimate.
- (9) The Cost-to-Complete Report indicated soil remediation by thermal desorption, which is not used for treating explosives. Again, we reviewed site descriptions in the IAPs for all these sites to verify whether this assumption was valid. In several cases, we chose to include the sites in our estimate.
- (10) The projected "Response Completion" (RC) date in the IAP indicated that remedial

action had been completed or was underway.

Although an exhaustive validation of these assumptions was not possible due to time constraints, discussions with knowledgeable personnel indicated the assumptions were reasonable in light of the information currently available. Our assumptions are documented above to facilitate alternative analyses based on different assumptions. After completing this elimination process, we assumed all remaining sites would require cleanup. Table B-1 lists the 54 remaining sites, the soil volume we estimated for each, and the RC dates.

**Table B-1. Contaminated Sites Requiring Cleanup**

Site #	Site Name	Kyd <sup>3</sup>	RC Date
<b>Aberdeen Proving Ground</b>			
EACC1F-A	Building E5604 Area	1	Dec 2025
EACC3E	Building E3300 / E3330 Lab Complex	1	Dec 2025
EACC3G	Building E360X Area	1	Dec 2025
EACC3I	Building E3570 Assembly Plant	1	Dec 2025
EACC3K-A	Building E37XX Complex	1	Dec 2025
EACI04-B	Decontamination Pits	1	Dec 2028
EACI08	Lower Island Disposal Area	1	Dec 2028
EAGQ03-C	AOC Associated with Site 8	1	Dec 2028
EAOE19	Fort Hoyle Area	1	Jun 2014
EAWW21-B	San Domingo Munitions Assembly Plant	1	Nov 2028
<b>Anniston AD</b>			
ANAD-10	TNT Washout Facility Sedimentation Tank	20	Jan 2022
ANAD-11	TNT Leaching Beds	7	Jan 2022
<b>ARDEC (Picatinny Arsenal)</b>			
PICA-001	Northern & Southern Tetryl Pits	1	Sep 2000
PICA-079	Buildings 809, 810 Explosives Manufacturing Waste Water Facility	4	Mar 2000
PICA-080	Building 1094 Laboratory Pack / Repacking Facility	1	Sep 2000
PICA-091	Buildings 221, 223 & 225 Machining of Explosives Facility	2	Mar 2000
PICA-131	Building 266 Ordnance Manufacturing	1	Mar 2000
PICA-132	Building 271 Load Facility	1	Mar 2000
PICA-145	Building 477 Explosives & Propellant Mixing Area	2	Mar 2000
PICA-151	Buildings 813, 816 & 816B Ordnance Facility	1	Mar 2000
PICA-152	Buildings 820 & 823 Ordnance Facility	1	Mar 2000
PICA-165	Building 1033 Explosives Loading	1	Sep 2000
PICA-167	Buildings 1373 & 1374 Propellant Plant / Ordnance Facility	1	Sep 2000
PICA-170	Buildings 1462, 1463 & 1464 Explosives Plants	1	Sep 2000
<b>Bluegrass AD</b>			
BLGR-012	Former Holding Ponds (Old TNT Washout Lagoons)	2	Jan 1997
<b>Camp Navajo</b>			
NAAD-07	TNT Retention Ponds	6	Dec 2000
NAAD-11B	Building 318 TNT Washout / Recovery	1	Dec 2003

<b>Dugway Proving Ground</b>			
DPG-199	Open Burn / Open Detonation Site	5	unknown
<b>Fort Irwin</b>			
FTIR-25E	Abandoned Open Detonation Site (Avawatz Dry lake Area)	4	Dec 1998
<b>Fort Wingate</b>			
FTWG-01	TNT Leaching Beds	25	unknown
FTWG-07	Building 530 Deactivation Furnace	1	unknown
none	Building 503 TNT Flaker Building	1	unknown
<b>Kansas AAP</b>			
KAAP-18, -31	700 Area Sumps, Ditches, and Ponds	24	Jun 1999
<b>Longhorn AAP</b>			
LHAAP-29	Former TNT Production Area	2	Apr 1998
LHAAP-32	Former TNT Waster Disposal Plant	2	Apr 1998
<b>Radford AAP</b>			
RAAP-011	Red Water Ash Burial Ground	10	unknown
<b>Ravenna AAP</b>			
RVAAP-08	Load Line 1 Dilution / Settling Pond	9	unknown
RVAAP-09	Load Line 2 Dilution / Settling Pond	17	unknown
RVAAP-10	Load Line 3 Dilution / Settling Pond	1	unknown
RVAAP-11	Load Line 4 Dilution / Settling Pond	17	unknown
RVAAP-12	Load Line 12 Dilution / Settling Pond	3	unknown
RVAAP-13	Bldg 1200 Dilution / Settling Pond	5	unknown
RVAAP-26	Fuze & Booster Area Settling Tanks	3	unknown
<b>Seneca AD</b>			
SEAD-004	Munitions Washout Facility Leach Field	9	unknown
SEAD-052	Buildings 608 & 612: Ammunition Breakdown Area	1	unknown
<b>Sunflower AAP</b>			
SAAP-004	Pond A & Sludge Disposal Area	68	Jun 2000
SAAP-011	F-Line Area Settling Pond	8	Sep 1998
SAAP-026	Single Base Propellant Area Water Settling Sumps	1	Jun 2000
SAAP-033	Paste Area Half Tanks & Settling Ponds	1	Sep 2001
SAAP-034	Five Corners Settling Ponds	1	Sep 2001
SAAP-035	Nitroglycerine Area Settling Ponds	1	Sep 2001
SAAP-048	Nitroguanidine Support Area	3	Sep 2001
<b>Volunteer AAP</b>			
VAAP-01	East Acid Area	1	Apr 2000
VAAP-32	TNT Manufacturing Valley	1	May 2007



# **Appendix C**

## **Sites Not Requiring Cleanup**

## Sites Not Requiring Cleanup

TRW documented all sites it investigated during this research. From our initial review of 35 Installation Action Plans (IAPs) and BRAC Cleanup Plans for the installations with known or suspected explosives contamination, we found 521 sites where explosives-contaminated soil had been listed as a concern. During our detailed review of these 521 sites, we determined that 467 sites either (a) did not have any explosives-contaminated soil or (b) had contamination levels so low they were unlikely to require treatment.

Table C-1 lists these 467 sites and our reasons for excluding them from further consideration. These reasons fall into two broad categories: (a) indications that no further action is planned and (b) indications that there is no significant explosives contamination. These two broad categories are further broken out by following:

**IAP:** The Installation Restoration Program (IRP) milestones status in the IAP (or BRAC Cleanup Plan) indicated that no further action is planned.

**C/IP:** The "Response Complete" date was 1997 or earlier, indicating that *site* cleanup has either been completed or is in progress.

**CTCR:** Under "no further action," this means the Cost-to-Complete Report did *not* include the site, indicating that further action is *not* planned. Under "no explosives," this means the Cost-to-Complete Report did not estimate a soil volume for remediation, indicating that contamination is not a problem.

**CCNE:** "Comparison criteria not exceeded" means that soil samples fell below established criteria for explosives contamination.

**NC:** Contaminated only by nitrocellulose, which was not among the contaminants of interest to USAEC for this report.

**RVW:** TRW's and USAEC's joint review of site descriptions and past site uses determined that explosives contamination is at low (residual) levels not requiring remediation.

**LF:** The Cost-to-Complete Report indicates that contaminated soil will be disposed in landfill (not consistent with explosives contamination).

**TD:** The Cost-to-Complete Report indicates soil treatment by thermal desorption (not consistent with explosives contamination).

**SOL:** The Cost-to-Complete Report indicates soil treatment by solidification (not consistent with explosives contamination).

**Prop:** The IAP indicates contamination by propellants only. (At USAEC's request, TRW also identified sites contaminated by propellants.)

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		LAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL	TD	Prop
	Aberdeen Proving Ground											
AAOA02	Surface Disposal Areas										●	
AAOA06	German Ammunition Train Explosion Area							●				
AAOA11	Waste Treatment Plant							●				
AAOA14	White Phosphorus Munitions Land Burial Area	●		●								
AAWP00	White Phosphorus Disposal Site	●	●	●								
AAWP01	White Phosphorus Underwater Munitions Burial Area	●	●	●								
EABR18-D	A-Field Test Sites	●		●								
EABR18-E	Bush River	●		●								
EACC1A-B	G Street Salvage Yard											●
EACC2G	Building E5103 Photo Lab						●					
EACC3N	Beach Point Test Site	●	●					●				
EACC5A	Canal Creek Bed Sediment Source Area								●			
EACI01-A	Bengies Point Road Dump			●								
EACI01-B	Bengies Point Road Farm House	●		●								
EACI01-C	Old Carroll Island Road Dump			●								
EACI01-D	AOC Associated with Site 10			●								
EACI02-A	Service Area			●								
EACI02-B	Dredge Spoil Site			●								
EACI02-C	Woods West of Service Area			●								
EACI04-A	Aerial Spray Grid / Decontamination Spray Area	●		●								
EACI04-C	Adamsite Pits	●		●								
EACI04-D	BZ Test Burn Pits						●					
EACI05-A	Test Grid 1	●		●								
EACI05-B	Magazine Area	●		●								
EACI05-C	Animal Shelter	●		●								
EACI05-D	Animal Shelter Woods			●								
EACI05-E	Push Back Mounds			●								
EACI06-A	Wind Tunnel	●		●								
EACI06-B	Woods North & South of Wind Tunnel Road	●		●								
EACI06-D	CS Test Area			●								
EACI06-E	CS Test Area Mounds			●								

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives						TD	Prop
		IAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL		
EACI07-A	VX Test Area			•								
EACI07-B	Test Grid 2			•								
EACI07-C	HD Test Area						•					
EAGQ01-A	Disposal Area			•								
EAGQ01-B	Grace Quarters Dump							•				
EAGQ01-C	Bunker Site	•		•								
EAGQ01-D	FEMA Service Area	•		•								
EAGQ01-E	FEMA Bunker	•		•								
EAGQ01-F	AOC Associated with Site 4			•								
EAGQ01-G	HD Test Annuli	•		•								
EAGQ01-H	Test Huts			•								
EAGQ01-I	Secondary Test Area			•								
EAGQ02-A	Northern Perimeter Dump						•					
EAGQ02-B	Southern & Southwestern Perimeter Dumps						•					
EAGQ02-C	Primary Test Area			•								
EAGQ03-A	Service Area	•		•								
EAGQ03-B	Dugway Proving Ground Test Site			•								
EAGQ03-D	Disposal Mounds at Dugway Site			•								
EAJF01	White Phosphorus Burning Pit	•		•								
EAJF05	Toxic Burning Pits	•	•									
EAJF05-A	Toxic Burning Pits - Southern Main Pits Overall		•									
EAJF06	South Beach Demolition Ground	•		•								
EAJF14	Robins Point Tower Site	•		•								
EALC20	School Field No. III	•		•								
EALC33	Monks Creek Farm	•		•								
EAOE16	M-Field Minefield										•	
EAOE22	L-Field Demolition & Propellant Disposal Site										•	
EAOE23	I-Field Japanese Bunker Area										•	
EAOE28	H-Field Concrete Target Areas										•	
EAOE29	Maxwell Point Test Site										•	
EAOE38	K-Field Demolition Field			•								
EAOE44	M-Field Bomblet Projector										•	

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives						TD	Prop
		IAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL		
EAOE53	I-Field Impact Area										•	
EAOF02	Old O-Field Source Area								•			
EAOW02-A	Debris Landfill						•					
EAOW02-C	Open Gravel Depression								•			
EAOW10-A	Roads End Disposal Site								•			
	<b>Anniston Army Depot</b>											
ANAD-14	Laundry Waste Leaching Facility							•				
ANAD-15	Propellant Disposal Facility			•								•
ANAD-16	Burning Ground	•	•	•								
ANAD-17	Demolition Pit	•	•	•								
ANAD-26	North TNT Burial Pit			•								
ANAD-27	South TNT Burial Pit			•								
	<b>ARDEC (Picatinny Arsenal)</b>											
PICA-002	Lower Burning Ground							•				
PICA-006	Guncotton Line								•			
PICA-007	Rocket Fuel Test Site G-2 Area								•			
PICA-008	Rocket Fuel Test G-1 Area (3500 Buildings)							•				
PICA-012	Building 3022 Physical Analysis Laboratory / Energetics							•				
PICA-013	Optics. Photo. Processing Facility Site Building 91							•				
PICA-018	Building 3045 Fluorochemical Storage								•			
PICA-019	Pyrotechnic Demolition Area	•		•								
PICA-020	Pyrotechnic Testing Range			•	•							
PICA-021	NG Processing Area								•			
PICA-023	Post Farm Landfill			•	•							
PICA-024	(unknown: site name not listed in IAP)			•	•							
PICA-025	Spicer Landfill			•	•							
PICA-026	Dredge Pile	•		•								
PICA-028	Sewage Treatment Plant Former Sludge Beds	•		•								
PICA-031	Buildings 314, 314B, & 314E			•	•							
PICA-037	Hazardous Waste Tank Storage											
PICA-047	Building 506 Power Plant								•			

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	GCNE	NC	RWV	CTCR	LF	SOL	TD	Prop
PICA-050	1500 Area Reaction Motors / Rocket Fuel Test								●			
PICA-052, 095, -096	Buildings 305, 306, & 336: Former Laundry Facility				●			●				
PICA-053	Test Area 1242								●			
PICA-054	Test Area Building 1222		●						●			
PICA-055	Test Area Building 670								●			
PICA-056	Chemical Burial Area (Site 10)							●				
PICA-057	Picatinny Lake								●			
PICA-058	Munitions Waste Pile								●			
PICA-059	Munitions & Pyrotechnics Test Area		●	●								
PICA-060	Munitions Test Area at 636	●							●			
PICA-061	Munitions Test Area Building 616								●			
PICA-064	Building 520 Poach House					●			●			
PICA-073	Building 553 Storage Tank								●			
PICA-074	Building 527A Storage Tanks								●			
PICA-075	Building 3100 Waste Storage Area								●			
PICA-081	Building 3114 PCB Storage Area								●			
PICA-082	Building 3157 (?) Pesticide Storage Area								●			
PICA-085	Building 507 90-Day Accumulation Area								●			
PICA-086	Building 3005, 3006 90-Day Accumulation Area				●				●			
PICA-087	Buildings 3314, 3315 90-Day Accumulation Area								●			
PICA-108	Building 424 Propellant Processing								●			
PICA-111	Building 435 Propellant Solvent Mixing				●				●			
PICA-117	Building 22 Former Precision Machine Shop			●								
PICA-118	Pesticide Storage Area & Oil Separator Pond			●	●							
PICA-122	Propellant Testing Building 197				●				●			
PICA-123	Hazardous Waste Storage / Fuse Assembly				●				●			
PICA-124	Building 241 Loading / Disassembly Plant				●				●			
PICA-125	Building 268 Mine Assembly Facility						●		●			
PICA-126	Building 276 Explosive Loading Facility								●			
PICA-127	Building 230 Melt Casting Operation								●			
PICA-129	Building 240 Change House								●			

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives						TD	Prop
		IAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL		
PICA-130	Building 252 Powder Press / Pelleting								•			
PICA-134	Building 302 R&D Laboratory / Warehouse				•				•			
PICA-135	Building 910 Metallurgical Laboratory						•		•			
PICA-136	Building 3013 High Pressure Boiler						•		•			
PICA-137	Building 908 X-ray Photo Processing Laboratory								•			
PICA-138	Electromagnetic Gun Test Shed				•				•			
PICA-139	Buildings 800 & 807 Ammunition Demilitarization / Ordnance Facility				•				•			
PICA-140	Building 501 Post Engine Maintenance Shop				•				•			
PICA-141	Building 429 Propellant Crushing						•		•			
PICA-142	Propellant Plant Building 511						•		•			
PICA-143	Building 436 Propellant Processing				•				•			
PICA-144	Building 462 Propellant Finishing				•				•			
PICA-146	Building 561 Propellant Plant				•				•			
PICA-147	Building 382 Administration Building								•			
PICA-148	Building 527 Change House								•			
PICA-149	Building 541 Propellant Plant								•			
PICA-150	Building 555 Propellant Plant								•			
PICA-153	Building 926 High Explosives Magazine								•			
PICA-154	Building 975 Supplies & Services Building								•			
PICA-155	TECUP Buildings								•			
PICA-156	Refrigeration & Inert Gas Plant								•			
PICA-157	3600 Building Motors / Rocket Fuel Test								•			
PICA-158	Helicopter Building								•			
PICA-159	Building 3328 Park Area								•			
PICA-160	Chemical Laboratory & Administration Building (Bldg 3404)								•			
PICA-161	Old Sewage Treatment Plant								•			
PICA-163	Building 1301 Rocket Motor Assembly Facility	•							•			
PICA-164	Reservoir near Building 3159								•			
PICA-166	Building 1029 Ordnance Facility								•			



Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		LAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL	TD	Prop
PICA-168	Buildings 1400, 1402 & 1403 Propellant Plant / Press House								●			
PICA-169	Buildings 1408, 1409 & 1411 Propellant Plants								●			
PICA-171	Buildings 3106, 3109 & 3111 Ordnance Facility								●			
PICA-172	Building 1031 Nitration Building								●			
PICA-173	Buildings 1070, 1071 & 1071C Explosives Magazine / Storage								●			
PICA-174	Buildings 1354 & 1357 Propellant Plant								●			
PICA-175	Building 611 Ordnance Facility								●			
PICA-176	Little League Baseball Field								●			
PICA-177	Sanitary Sewer Lines								●			
PICA-178	Building 604 Ordnance Facility								●			
PICA-179	Building 606 Ordnance Facility								●			
PICA-180	Buildings 617 & 617G Field Office / Disassembly	●			●				●			
PICA-181	Building 620 Ordnance Facility								●			
PICA-182	Building 5	●	●	●								
PICA-183	Building 1217 General Purpose Magazine								●			
PICA-184	1600 Buildings								●			
PICA-185	Buildings 46 - 48 Propellant Storage								●			
PICA-186	Building 50 Propellant Storage								●			
PICA-187	Building 57 Chemical Storage								●			
	Bluegrass Army Depot											
BLGR-002	Bldg 1161 Mustard Shell Demilitarization Area	●	●	●								
BLGR-006	Mustard Burn Site	●						●				
BLGR-010	Former Shell Washout Facility (Bldg 1155) (Old TNT Washout Facility)	●	●	●								
BLGR-011	Shell Washout Facility (New TNT Washout Facility)	●	●	●								
BLGR-013	Holding Ponds (New TNT Washout Lagoons)	●		●								
BLGR-014	Surveillance (Test) Range	●	●	●								
BLGR-021	Deactivation Furnace	●	●					●				
BLGR-029	Pink Water Pond Area	●	●							●		
BLGR-030	Open Detonation Area	●	●					●				

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL	TD	Prop
BLGR-031	Former Projectile Propellant Burn Area	●									●	
BLGR-032	New Propellant Burn Area	●	●	●								
BLGR-038	F Block Igloos	●	●					●				
BLGR-042	DRMO Storage Area	●	●	●								
BLGR-048	Area B & G Igloos	●	●					●				
	Camp Navajo											
NAAD-02	Explosives Demolition Area		●	●								
NAAD-03	Former White Phosphorus Detonation / Burn Area										●	
NAAD-04, -44	Former CK/CG Demilitarization Area; Drum Burial Site in Demo Area										●	
NAAD-05	Former Open Burn Area			●								
NAAD-06	Open Burn / Open Detonation Waste Pile & Burn Area			●								
NAAD-08	Former Open Burn Areas			●								
NAAD-09	Closed Open Burn Areas			●								
NAAD-11A	Building 316 Laundry Facility & Wastewater Lagoon	●	●	●								
NAAD-12	Former TNT Washout Lagoons	●										
NAAD-13	Former Deactivation Furnace, Ash Disposal Pile, Ash Storage	●	●	●								
NAAD-15B	Building 301 Paint Operations (Current Ammunition Workshop) & Building 310 Renovating Ammunition	●	●	●								
NAAD-17	D-200 Series Igloos	●	●	●								
NAAD-18	D-300 Area Igloos & "Y"	●	●	●								
NAAD-22, -23	Wastewater Treatment		●	●								
	Dugway Proving Ground											
DPG-002	Waste Pile at North End of Granite Peak								●			
DPG-004	GPI-2 Complex (Old Baker Lab)									●		
DPG-009, 009A	Granite Peak Storage Area for 3X Scrap Materials							●				
DPG-014	Landfill near intersection of Downwind West & Juliet Road							●				
DPG-033	Baker Sewage Lagoon							●				
DPG-036	DTC Imhoff Tank & Drain Field							●				
DPG-037	DTC Landfill in DTA							●				

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL	TD	Prop
DPG-039	Avery Landfill							●				
DPG-042	Contractor's Landfill at English Village							●				
DPG-043	Old Landfill at English Village							●				
DPG-054	Landfill East of Carr Facility						●					
DPG-059	Pad 7 - 3X Storage Area						●					
DPG-090	Carr Open Burn Area							●				
DPG-099	3X Solids Storage Area at Camelback Ridge							●				
DPG-118	Concrete Vat								●			
DPG-168	Carr Wash Rack / Open Transfer Shed							●				
	Fort Carson											
FTC-017	Abandoned Open Burn Grounds, Range 1	●										●
FTC-018	Abandoned Open Burn Grounds, Range 1A	●						●				●
FTC-019	Range 121 Open Detonation Grounds	●						●				
FTC-027	Deactivated Trenches at Range 123, Open Burn Grounds	●						●				
FTC-040	Open Dumping Area, Range 121	●						●				
FTC-048	Abandoned EOD Demolition Area	●						●				
	Fort Gordon											
FTGD-021	Western Small Arms Burning Ground			●								
FTGD-022	Artillery Impact Area / Demolition Ground									●		
FTGD-036	Former Small Arms Burning Ground		●						●			
FTGD-038	Magazine Area			●								
FTGD-039	Gas Chamber								●			
	Fort Irwin											
FTIR-02	Abandoned Sanitary Landfill							●				
FTIR-03	Sanitary Landfill 3	●	●						●			
FTIR-04	Abandoned Sanitary Landfill 4							●				
FTIR-05	Suspected Abandoned Landfill	●	●	●								
FTIR-07	Lucky Fuse Impact Disposal Area								●			
FTIR-08	Awawatz Valley Disposal Site								●			
FTIR-22	Trinity Range											
FTIR-23	Lucky Fuse Impact Disposal Area OD Site			●								

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives						TD	Prop
		IAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL		
FTIR-24	CAS-6 OD Site			•								
FTIR-25B	Abandoned Open Detonation Site (Leach Lake)			•								
FTIR-25C	Abandoned Open Detonation Site (Gary Owen Impact Area)			•								
FTIR-25D	Abandoned Open Detonation Site (Langford Impact Area)			•								
FTIR-25F	Abandoned Open Detonation Site (Nelson Impact Area)			•								
FTIR-41	Combat Engineers Range Open Burn / Open Detonation Site								•			
	<b>Fort Riley</b>											
FTRI-009	Open Burn / Open Detonation Ground (Range 16)							•				
FTRI-032	Impact Zone							•				
	<b>Fort Sill</b>											
FTSL-022	Crater Creek Canyon Demolition Area						•					
FTSL-023	Bateman Woods Demolition Area						•					
FTSL-024	South Arbuckle Demolition Area						•					
FTSL-025	Chatto Flats Demolition Area						•					
FTSL-026	Powder Burn Area 1 (Adams Hill)	•	•	•								
FTSL-027	Powder Burn Area 2 (Bald Ridge Road)							•				
FTSL-028	Powder Burn Area 3 (Apache Gate)	•	•	•								
FTSL-029	Powder Burn Area 4 (Chrystie Hill)								•			
FTSL-030	Powder Burn Area 5 (Tower Two Road)							•				
FTSL-031	Powder Burn Area 6 (Gate 6)	•	•	•								
FTSL-032	Powder Burn Area 7 (Blue Beaver Creek)		•				•					
FTSL-033	Powder Burn Area 8 (Quannah Range)	•	•	•								
FTSL-047	Quannah Range EOD Landfill								•			
	<b>Fort Wingate</b>											
FTWG-34	Open Burn / Open Detonation Area							•				
none	Sewage Treatment Plant			•								
none	Building 501 (TNT Recovery)			•								
none	Building 528 (Ammunition Maintenance)			•								
none	Igloo Blocks A-H, J, K			•								

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL	TD	Prop
none	Missile Sites			●								
none	Function Testing Ranges 1, 2, 3			●								
Holston Army Ammunition Plant												
HSAAP-01	Landfills											
HSAAP-15	Burning Ground							●				
HSAAP-16	Proof Testing Range B-8							●				
HSAAP-23	Area B Production Drainage Ditches & Streams	●	●					●				
HSAAP-33	Former Solvent Burn Tank Area at Burning Ground							●				
	Miscellaneous Storage Areas requiring Confirmatory											
HSAAP-38	Sampling	●						●				
HSAAP-39	Past Spill Sites	●						●				
Indiana Army Ammunition Plant												
INAAP-01	Old Landfill											
INAAP-03	North Ash Settling Basin							●				
INAAP-04	South Ash Settling Basin							●	●			
INAAP-05	Aniline Pond										●	
INAAP-06	Process Waste Settling Basin							●				
INAAP-08	Bldg 229-1			●								
INAAP-10	P & E Area Sewage Treatment Plant			●								
INAAP-13	LAP Area Sewage Treatment Plant			●								
INAAP-16	P & E Area Neutralization Facility	●		●								
INAAP-17	Burning Ground								●			
INAAP-18	Flash Rack								●			
INAAP-19	Salvage Yard			●								
INAAP-20	Caustic Cleaning Facility			●								
INAAP-21	Bldg 229-156	●		●								
INAAP-22	Suspected Propellant Burial Site	●		●								●
INAAP-23	P & E Sinkhole	●		●								
INAAP-24	Suspected Propellant Burial Area								●			
INAAP-25	Jenny Lind Pond							●				
INAAP-26	Old Trash Burning Ground								●			

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		LAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL	TD	Prop
INAAP-27	Bldg 714-5 (Lead Smelting Shed)		●			●						
INAAP-29	Bldg 228-1 Septic tank	●		●								
INAAP-32	Bldg 706-3 (Laboratory)		●					●				
INAAP-34	Trash Incinerator								●			
INAAP-35	Bldg 706-1 (Laboratory)		●					●				
INAAP-36	Bldg 228-1 (Ballistics Lab)	●	●	●								
INAAP-38	Inert Area Can Burial			●								
INAAP-39	Plant Sanitary Sewer Systems							●				
INAAP-46	Bluff Dumping Area								●			
INAAP-47	Powder Preparation Can Burial Area	●		●								
INAAP-48	Rail Shiphouse Can Storage Area							●				
INAAP-49	1500 Area Disposal Pit			●								
INAAP-50	Screening Building Sumps (2 locations)	●		●								
INAAP-51	Rail Shiphouse Burial Area	●		●								
INAAP-52	Rail Car Burning Area	●		●								
INAAP-54	P & E Flume		●								●	
INAAP-55	Former Inert Area Burning Ground	●		●								
INAAP-56	Powder Incinerator	●		●								
INAAP-59	Ravine Dumping Area								●			
INAAP-60	Burning Ground Landfill							●				
INAAP-61	Inert Area Can / Drum Storage Area		●					●				
INAAP-62	Bldg 706-4 (Laboratory)	●	●					●				
INAAP-63	P & E Area							●				
INAAP-65	Rail Shiphouses			●								
INAAP-66	Static Test Area	●	●	●								
INAAP-67	Former Burning Ground	●	●	●								
INAAP-69	Construction Debris Landfills							●				
INAAP-70	Bldg 706-2 (Laboratory)	●	●	●								
INAAP-74	Black Powder Plant	●	●	●								
INAAP-75	LAP Area		●					●				
INAAP-76	Igloo Area		●	●								
INAAP-77	Truck Shiphouse Area		●	●								

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives						TD	Prop
		LAP	C/I/P	CTCR	CCNE	NC	RWV	CTCR	LF	SOL		
INAAP-78	Bldg 2525 (Container Renovation)		•					•				
INAAP-82	Burial Pit							•				
INAAP-89	Jenny Lind Run Drainage Basin (Propellant Contaminated Sediments)										•	
<b>Kansas Army Ammunition Plant</b>												
KAAP-01	100 Area Classification Area							•				
KAAP-05	Current Active Landfill								•			
KAAP-06	Grenade Pit			•								
KAAP-07	Asbestos Waste Landfill			•								
KAAP-08	Fly Ash Disposal Pit			•								
KAAP-09	Burning Cages #14, 17, & 22								•			
KAAP-10	Open Burning Pads 5 & 6 and Pads 1-4										•	
KAAP-12	Old Ammunition Storage Area	•		•								
KAAP-14	Pink / Red Water Treatment Systems	•		•								
KAAP-15	Sewage Treatment Plant								•			
KAAP-16, -30	300 Area Wastewater Sumps, Ditches, and Oxidation Ponds							•				
KAAP-17	500 Area Wastewater Sumps and Discharge Plants										•	
KAAP-19	800 Area Wastewater Sumps, Ditches, and Oxidation Ponds										•	
KAAP-20, -32	900 Area Wastewater Sumps, Ditches, and Oxidation Ponds										•	
KAAP-21, -33	1000 Area Wastewater Sumps, Ditches, and Oxidation Ponds										•	
KAAP-22	1100 Area Wastewater Sumps, Ditches, and Oxidation Ponds										•	
KAAP-23	Waste Analysis Chemistry Laboratory	•	•	•								
KAAP-24	Explosive Waste Incinerator						•					
KAAP-34	1200 Oxidation Ponds	•		•								
KAAP-35	100 Area Laundry Sump & Pond										•	
KAAP-37	Open Detonation Grounds										•	
KAAP-38	Contaminated Waster Processor							•				

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		LAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL	TD	Prop
Lake City Army Ammunition Plant												
LCAAP-001 ("and 29 others")	Installation-wide Operable Unit											
LCAAP-008	Area 8 Operable Unit							●				
LCAAP-011	Burning Ground							●				
LCAAP-016	Abandoned Landfill							●				
LCAAP-017	Sanitary Landfill & Solvent Pits							●				
Letterkenny Army Depot												
LEAD-017	Projectile Range	●	●	●								
LEAD-031	Laundry for Explosives-contaminated Clothing (Bldg 2357)	●	●	●								
LEAD-045	Demolition Ground One	●	●	●								
LEAD-046	Demolition Ground Two								●			
LEAD-047	Burning Ground One	●	●	●								
LEAD-050	TNT Washout Plant							●				
LEAD-053	Burning Ground Two								●			
LEAD-056	Residue Drum Storage Area	●	●	●								
Lonestar Army Ammunition Plant												
LSAAP-002	Western Inactive Landfill								●			
LSAAP-004	Eastern Inactive Landfill							●				
LSAAP-017	Old Demo Ground								●			
LSAAP-018	High Explosive Demolition Ground								●			
LSAAP-038	Area W Wells	●		●								
LSAAP-055	XX Test Area							●				
LSAAP-068	RDX Pits							●				
LSAAP-073	RDX Pit K-2	●		●								
LSAAP-074	P & Q Settling Pits											
LSAAP-075	K-15 South & K-15 North							●				
LSAAP-078	Open Burning Area Demolition Debris Fill Area			●								
LSAAP-201	Lead Wastewater Sumps & Tanks								●			
LSAAP-422	B-8 Battery Washdown Sump	●		●								



Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		LAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL	TD	Prop
LSAAP-499A	Pinkwater Treatment Facilities & Auxiliary Equipment	●		●								
LSAAP-499B	Contaminated Production Area Sewer Lines P & Q			●								
LSAAP-499E	Industrial Sewer Lift Station P-78 & Pipes			●								
Longhorn Army Ammunition Plant												
LHAAP-01	Inert Burning Grounds		●	●								
LHAAP-11	Suspected TNT Burial Site at Avenues P & Q							●				●
LHAAP-13	Suspected TNT Burial between Active Landfill and Old Landfill	●	●	●								
LHAAP-14	Area 54 Burial Ground	●	●	●								
LHAAP-16	Old Landfill							●				
LHAAP-17	Flashing Area / Burning Ground								●			
LHAAP-22	TNT Red Water Pipeline			●								
LHAAP-27	South Test Area							●				●
LHAAP-35	Process Waste Water Sumps (various)						●					
LHAAP-49	Former Acid Plant			●								
LHAAP-52	Magazine Area		●						●			
LHAAP-53	Static Test Area	●	●	●								
LHAAP-54	Ground Signal Test Area		●						●			
LHAAP-63	Burial Pits		●						●			
McAlester Army Ammunition Plant												
MCAAP-019	Rocket Lake	●	●	●								
MCAAP-044	Brown Lake	●	●	●								
Radford Army Ammunition Plant												
RAAP-001	TNT Waste Acid Neutralization Pits											
RAAP-005	Burning Ground							●				
RAAP-007	Active Sanitary Landfill							●				
RAAP-009	Landfill in Nitro Area									●		
RAAP-013	Red Water Ash Burial 2											
RAAP-014	Burial Area of Propellant Ash										●	
RAAP-016	Waste Water Ponds from Propellant Incinerators							●				
RAAP-021	Propellant Burial	●		●								●

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	CCNE	NC	RWV	CTCR	LF	SOL	TD	Prop
RAAP-029	(unknown: site name not listed in IAP)			●								
RAAP-030	Air Curtain Destructor & Open Burn Area								●			
RAAP-036	Bioplant Basin			●								
	Ravenna Army Ammunition Plant											
RVAAP-01	Ramsdell Quarry Landfill							●				●
RVAAP-02	Erie Burning Grounds										●	
RVAAP-03	Demolition Area #1									●		
RVAAP-04	Demolition Area #2									●		
RVAAP-05	Winklepeck Burning Grounds						●					
RVAAP-14	Load Line 6 Evaporation Unit	●	●	●								
RVAAP-15	Load Line 6 Treatment Plant							●				
RVAAP-16	Quarry Landfill / Pond							●				
RVAAP-18	Load Line 12 Pink Waste Water Treatment							●				
RVAAP-19	Landfill North of Winklepeck Burning Grounds								●			
RVAAP-29	Upper & Lower Cobbs Ponds							●				
RVAAP-30	Load Line 7 Pink Waste Water Treatment	●	●	●								
RVAAP-31	Ore Pile Retention Pond	●	●					●				
RVAAP-33	Firestone Test Facility									●		
RVAAP-35	Bldg 1037 Laundry Waste Water Tank									●		
	Red River Army Depot											
RRAD-26	Aeration Lagoon in Area K	●	●	●								
RRAD-49	TNT Washout Facility Soil	●		●								
RRAD-50	OB / OD Area	●						●				
RRAD-59	D-Area Y-Site	●		●								
	Redstone Arsenal											
MSFC-034	Inactive Mechanical Room Sump, Building 4481						●					
MSFC-053	Former Propellant Storage Area & Test Stand Site											●
MSFC-055	Dismantled Stauffer Chemical Manufacturing Plant Site						●					
RSA-013	Inactive Unlined Earthen Open Burn Pads							●				
RSA-014	Inactive Unlined Earthen Open Burn Trenches							●				
RSA-071	High Explosive Drop Area	●		●								

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL	TD	Prop
RSA-072	Mortar Shell Test Area B	●		●								
RSA-073	High Explosive Impact Area C	●		●								
RSA-074	High Explosive Impact Area D	●		●								
RSA-108	2.75 Rocket Impact Site			●								
RSA-131	Active Open Detonation Area, Unit 2	●		●								
RSA-133	Inactive Rocket Motor Washrack & Sump							●				●
RSA-134	Inactive Disposal Trench / Open Burning Pit							●				
RSA-A	Inactive Propellant Storage Wells, South Plant							●				
RSA-B	Abandoned Army Propellant Manufacturing Bldg 7598							●				●
RSA-C	Abandoned Army Propellant Mixer Bldg 7596, South Plant							●			●	●
Seneca Army Depot												
SEAD-023	Open Burning Ground								●			
SEAD-046	Small Arms Range								●			
Sunflower Army Ammunition Plant												
SAAP-005	Pond A Neutralization Area									●		
SAAP-010	F-Line Ditches									●		
SAAP-012	Pyott's Pond & Sludge Disposal Areas							●				
SAAP-014	Rocket Static Test Area									●		
SAAP-015	Waste Storage Magazines			●								
SAAP-017	G-Line Area Ditches							●				
SAAP-021	Contaminated Materials Burning Ground										●	
SAAP-022	Old Waste Explosives Burning Ground							●				
SAAP-023	New Explosives Waste Burning Ground							●				
SAAP-024	Nitroglycerine Ditches							●				
SAAP-025	Nitrocellulose Area Ditches							●				
SAAP-031	Contaminated Waste Processor / Evaporation Lagoons							●				
SAAP-036	N-Line Area								●			
SAAP-045	Bldg 9040 (Calcium Cyanamide Conveyors & Storage Unit)							●				
SAAP-047	Nitroguanidine Production Area Sumps							●				

Table C-1. Sites Not Requiring Cleanup

SITE #	Site Name	No Further Action			No Explosives							
		IAP	C/IP	CTCR	CCNE	NC	RW	CTCR	LF	SOL	TD	Prop
	<b>Twin Cities Army Ammunition Plant</b>											
TCAAP-23	Building 135 Primer / Tracer Area								●			
TCAAP-28	Building 535 Primer / Tracer Area								●			
	<b>Volunteer Army Ammunition Plant</b>											
VAAP-15	Burning Ground / New Landfill						●					
VAAP-16	Burning Ground (WWII)						●					
VAAP-33	New Acid Area							●				
	<b>White Sands Missile Range</b>											
GRTS-06	Magazine Area			●								
WSMR-02	Red Rio Munitions Disposal Areas							●				
WSMR-03	Oscara Munitions Disposal Area			●								
WSMR-04	Oscara Range Impact Area			●								
WSMR-12	Open Burn / Open Detonation Disposal Pits Hazardous Test Area		●						●			
WSMR-23	Tula Peak Burial Pits			●								
WSMR-24	Tula Peak Burial Site Incinerator			●								
WSMR-58	Vandal Burial Site		●	●								
WSMR-70	Landfill at Stallion Range Center							●				

# **Appendix D**

## **Volume Estimation Methods**

## Volume Estimation Methods

The IAPs and BRAC Cleanup Plans did not generally include site dimensions or estimated soil volumes, so for most sites TRW used the estimated soil volume from the Cost-to-Complete Report. In all cases, we rounded these volumes up to the next kilocubic yard.

The BRAC Cleanup Plan for Fort Wingate estimated soil volumes for all three sites requiring cleanup; these estimates were also rounded up to the next kilocubic yard.

The IAPs provided dimensions or surface area for nine sites, identified in Table D-1, making it possible to estimate soil volumes independently of the Cost-to-Complete Report. For four of the nine sites, the IAP gave only the surface area. We converted this area to a length and width, using 43,560 square feet for one acre and assuming a rectangular shape and a 3:2 ratio for the sides. The dimensions based on this assumption are shown in *italics* in Table D-1, but for the other five sites, we listed the dimensions we took from the IAPs.

**Table D-1. Dimensions and Alternate Volume Estimates for Nine Selected Sites**

Site	Area	Length (ft)	Width (ft)	Depth (ft)	Volume (Kyd <sup>3</sup> )
ANAD-11	0.75 acre	<i>221</i>	<i>148</i>	8	6.405
RVAAP-08	1 acre	<i>256</i>	<i>170</i>	8	8.46
RVAAP-09		295	295	8	16.668
RVAAP-11		361	241	8	16.675
RVAAP-13	0.5 acre	<i>182</i>	<i>120</i>	8	4.33
SAAP-004 pond sludge area	86,200 sq ft	<i>359</i>	<i>240</i>	8	16.516
	6.4 acres	<i>647</i>	<i>431</i>	5	50.648
SAAP-011 4 ponds 2 ponds 2 ponds		80	50	8	0.867 (each) 3.469 (total)
		70	40	8	0.627 (each) 1.254 (total)
			100 dia.	8	1.604 (each) 3.208 (total)
SAAP-034 2 ponds		40	40	8	0.377 (each) 0.754 (total)
SAAP-035 2 ponds		40	30	8	0.293 (each) 0.586 (total)

We used these site dimensions to estimate soil volumes for the sites. Figures D-1 and D-2 show the geometries we assumed for rectangular and round lagoons, respectively. We also made the following additional assumptions for estimating the amount of soil for excavation.

- (1) We assumed that the length and width (or diameter) of lagoons were measured at the top, rather than at the bottom, of the lagoons.
- (2) For non-BRAC sites, we assumed excavation of only five feet of contaminated soil from the bottom of the lagoons (and five feet laterally). The thickness of the excavated layer is denoted as  $t$  in Figures D-1 and D-2. Actual excavation depths will depend on contamination levels discovered after soil sampling during site preparation. (Soil samples at UMDA revealed that contamination levels were insignificant below 3.5 feet.) We did not calculate alternate estimates of soil volumes for the five BRAC sites (at Ft. Wingate and Seneca AD) because the BRAC Cleanup Plans did not provide site dimensions. For BRAC sites, we would have assumed a fifteen foot excavation per USAEC guidance.
- (3) We assumed a 45 degree slope for the walls of lagoons and ponds. (At UMDA, walls were sloped 35 degrees.)
- (4) We assumed lagoons and ponds would be eight feet deep. (Depth is denoted as  $h$  in the figures to distinguish it from diameters, denoted by  $d$ .) This assumption is consistent with IAP descriptions of several lagoons. (The sludge area at SAAP-004 was not a lagoon, so we estimated the volume based on excavation of five feet of soil from the top of the bed.)

In general, for both rectangular and round lagoons, our estimated soil volume,  $V_s$ , is:

$$V_s = V_o - V_i, \text{ where}$$

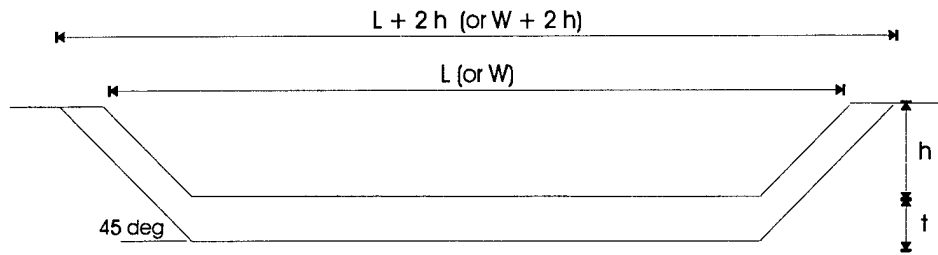
$V_o$  is the larger, outer volume that includes both contaminated soil and the capacity of the lagoon itself, and

$V_i$  is the smaller, inner volume (capacity) of the lagoon.

The formula for calculating the volume of any rectangular truncated pyramid (frustum) is:

$$V = L W H - W H^2 - L W^2 + (4 / 3) H^3,$$

where  $L$ ,  $W$ , and  $H$  are the appropriate dimensions for either  $V_i$  or  $V_o$ . This formula can be derived through a piecewise construction of the frustum or by integrating a differential volume  $dV$  over the appropriate limits for  $x$ ,  $y$ , and  $z$ .

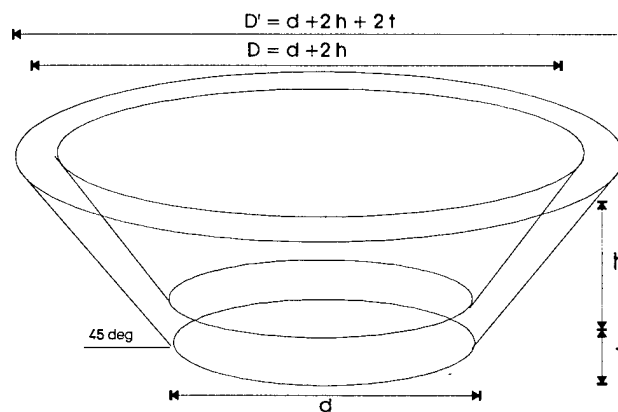


**Figure D-1. Geometry for Estimating Soil Volume of Rectangular Lagoons**

The general formula for round lagoons (the frustum of a cone, as shown in Figure D-2) is:

$$V = (\pi / 12) H [D^2 + D d + d^2].$$

This formula is found in many common engineering and mathematics references. The estimated soil volume is, again, found by subtracting the smaller (interior) volume from the larger (outer) volume as described above.



**Figure D-2. Geometry for Estimating Soil Volume of Round Lagoons**

We converted all soil volumes to kilocubic yards by dividing by 27,000 cubic feet per kilocubic yard, then rounded the results up to the next kilocubic yard. Table D-1 shows our estimates before rounding up.